

What is claimed is:

1. A sleeve having a tubular shape with openings at opposite ends and a continuous side wall between the openings, the side wall including a first band having a thermally insulating fabric bonded to a metal foil and a second band having a scrim layer bonded to a metal foil, the first band being arranged on a spiral path and the second band overlaying the seam between adjacent turns of the first band, and the second band bonded to the first band.
2. A sleeve of claim 1, wherein the metal foil of the first band is thinner than the fabric.
3. A sleeve of claim 2, wherein the metal foil of the first band is at least 1/4 the thickness of the fabric.
4. A sleeve of claim 2, wherein the metal foil of the first band is at least 1/5 the thickness of the fabric.
5. A sleeve of claim 2, wherein the fabric has a thickness of about 0.02 inch.
6. A sleeve of claim 2, wherein the fabric has a thickness of about 0.03 inch.
7. A sleeve of claim 2, wherein the metal foil of the first band has a thickness of about 0.005 to 0.0005 inch.
8. A sleeve of claim 2, wherein the metal foil of the first band has a thickness of about 0.001 inch.
9. A sleeve of claim 1, wherein the first band has an edge in one turn that abuts an opposite edge of the first band in an adjacent turn.

10. A sleeve of claim 1, wherein the fabric has a temperature resistance up to about 1000°F.
11. A sleeve of claim 1, wherein the fabric includes at least one of fiberglass,
5 carbon fiber and ceramic fiber.
12. A sleeve of claim 1, wherein the fabric has a plain weave.
13. A sleeve of claim 1, wherein the fabric has a weight of about 18 oz./yd.².
- 10 14. A sleeve of claim 1, wherein the metal foil of the first band and the metal foil of the second band each include at least one of aluminum and an aluminum alloy.
- 15 15. A sleeve of claim 1, further comprising an adhesive layer between the first band and the second band.
16. A sleeve of claim 15, wherein the adhesive layer has a thickness of about two times the thickness of the metal foil of the first band.
- 20 17. A sleeve of claim 15, wherein the adhesive has a thickness of about 0.00125 inch.
18. A sleeve of claim 1, wherein the scrim layer of the second band has an open weave.
- 25 19. A sleeve of claim 18, wherein the scrim layer includes a 0.2 inch spaced rectangular grid.
- 30 20. A sleeve of claim 19, wherein an adhesive in the scrim bonds the scrim to the metal foil of the second band and bonds the second band to the first band.

21. A sleeve of claim 1, wherein the scrim layer includes fiberglass fibers.
22. A sleeve of claim 1, wherein the scrim layer is made of fibers that have sufficient strength and flexibility at a maximum expected operating temperature.
- 5 23. A sleeve of claim 1, wherein the metal foil of the second band has a thickness of about 0.003 to 0.0003 inch.
24. A sleeve of claim 1, wherein the metal foil of the second band has a thickness
10 of about 0.007 inch.
25. A sleeve of claim 23, wherein a first adhesive bonds the fabric and the metal foil of the first band, a second adhesive bonds the scrim layer and the metal foil of the second band, and a third adhesive bonds the first band and the second band, and each adhesive is
15 selected from the group that includes a thermoplastic adhesive, a pressure sensitive adhesive, a thermosetting adhesive, a heat-activated adhesive and a polyethylene copolymer.
26. A sleeve of claim 1, wherein the second band and the first band have the same width, and the second band is offset from the first band by one half the width.
20
27. A sleeve of claim 1, wherein the first and second bands are wound along respective spiral paths.
28. A sleeve of claim 27, wherein the helix angles of the respective bands are
25 different and are selected to maintain the offset.
29. A sleeve having a tubular shape with openings at opposite ends and a continuous side wall between the openings, the side wall including a first band having a thermally insulating fabric bonded to a metal foil, a second band having a polyester layer
30 bonded to a metal layer, and a third band having a polyethylene layer bonded to a metal foil,

each band being arranged on a spiral path, the second band overlaying the seam between adjacent turns of the first band, the third band overlaying the seam between adjacent turns of the second band, the first band bonded to the second band and the third band bonded to the second band.

5

30. A sleeve of claim 29, wherein the polyester layer has a thickness of about 0.001 to 0.005 inch.

31. A sleeve of claim 29, wherein the metal layer of the second band has a
10 thickness of about 0.00048 inch.

32. A sleeve of claim 29, wherein each band has the same width and each band is offset from an adjacent band by one third the width.

15 33. A sleeve of claim 29, wherein a first adhesive bonds the fabric and the metal foil of the first band, a second adhesive bonds the polyester layer and the metal foil of the third band, a third adhesive bonds the first band and the second band, and a fourth adhesive bonds the third band to the second band, and each adhesive is selected from the group that includes a thermoplastic adhesive, a pressure sensitive adhesive, a thermosetting adhesive, a
20 heat-activated adhesive and a polyethylene copolymer.

34. A method of making an insulating sleeve, comprising the steps of:
supplying a first band having a metal foil superimposed on a thermally insulating fabric;
supplying a second band having a metal foil superimposed on a scrim layer;
25 winding the first band along a spiral path and overlaying the second band over a seam between adjacent turns of the first band; and
adhering the first band to the second band.

35. A method of claim 34, wherein the supplying steps include supplying the first
30 and second bands on respective spools to a spiral wrapping machine.

36. A method of claim 34, wherein the winding step includes winding at least the second band such that an edge of the band in one turn abuts an opposite edge of the band in an adjacent turn.

5 37. A method of claim 34, wherein the winding step includes offsetting the second band from the first band by one half the width of the outer band.

38. A method of claim 34, wherein the winding step includes winding the first band and the second band at different helix angles.

10

39. A method of claim 34, wherein the winding step includes wrapping the first band around a mandrel of a spiral wrapping machine.

15 40. A method of claim 34, further comprising the step of heating at least one of the bands to bond the bands together.

41. A method of claim 40, wherein the heating step includes blowing heated air on at least one of the bands.

20 42. A method of claim 40, further comprising the step of pressing the bands together after heating.

43. A method of claim 40, further comprising the step of pressing the bands together before heating.

25

44. A method of claim 40, wherein the heating step includes preheating at least one of the bands before the winding step.

45. A method of claim 34, further comprising the step of applying an adhesive to at least one of adjacent outer and inner surfaces of the first and second bands, respectively, to bond the first and second bands together.

5 46. A method of claim 45, further comprising the step of activating the adhesive.

47. A method of claim 46, wherein the activating step includes heating at least one of the bands.

10 48. A method of claim 34, further comprising the step of applying a cohesive on both an inner surface of the second band and an outer surface of the inner band to bond the inner and outer bands together.

15 49. A method of claim 48, further comprising the step of pressing the first and second bands together.

50. A method of claim 34, further comprising the step of flattening the sleeve.

20 51. A sleeve having a tubular shape with openings at opposite ends and a continuous side wall between the openings, the side wall including an first band having a thermally insulating fabric bonded to a metal foil, a second band having a scrim layer bonded to a metal layer, and a third band having a fabric layer bonded between a first metal foil layer and a second metal foil layer, each band being arranged on a spiral path, the second band overlaying the seam between adjacent turns of the first band, the third band overlaying the
25 seam between adjacent turns of the second band, the first band bonded to the second band and the third band bonded to the second band.

52. A sleeve of claim 51, wherein the first metal foil layer has a thickness of about 0.0001 to 0.0005 inch.

30

53. A sleeve of claim 51, wherein the second metal foil layer has a thickness of about 0.0001 to 0.001 inch.

54. A sleeve as in claim 51, wherein the fabric layer of the third band has a plain
5 weave.

55. A sleeve as in claim 54, wherein the fabric layer has a weight of about 3 oz./yd².

56. A sleeve as in claim 51, wherein the scrim layer of the second band has an
10 open weave.

57. A sleeve as in claim 56, wherein the scrim layer includes a rectangular grid.

58. A sleeve as in claim 51, wherein the metal layer of the second band has a
15 thickness of about 0.0003 to 0.003 inch.

59. A sleeve as in claim 51, wherein the thermally insulating fabric of the first
layer has a plain weave.

20

60. A sleeve as in claim 59, wherein the thermally insulating fabric has a weight of
18 oz./yd².

61. A sleeve as in claim 51, wherein the metal foil of the first band has a thickness
25 of about 0.005 to 0.0005 inch.

62. A sleeve of claim 51, wherein each band has a width that is substantially equal
to the other bands.

30

63. A sleeve of claim 51, wherein each band is offset from an adjacent band by one third the width.

5 64. A sleeve as of claim 51, wherein the bands are bonded to each other with an adhesive.

65. A sleeve as of claim 51, wherein the thermally insulating fabric of the first band has a plain weave and a weight of about 18 oz./yd² and the metal foil of the first band has a thickness of about 0.005 to 0.0005 inch; the scrim layer of the second band has an open
10 weave having a rectangular grid and the metal layer of the second band has a thickness of about 0.0003 to 0.003 inch; the first metal foil layer of the third band has a thickness of about 0.0001 to 0.0005 inch and the second metal foil layer has a thickness of about 0.0001 to 0.001 inch and the fabric layer of the third band has a plain weave and a weight of about 3 oz./yd².

15 66. A sleeve of claim 65, wherein each band has a width that is substantially equal to the other bands.

67. A sleeve of claim 65, wherein each band is offset from an adjacent band by one third the width.
20

68. A sleeve as of claim 65, wherein the bands are bonded to each other with an adhesive.

25